AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

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50. (New) A wireless communication receiver comprising:

an antenna structure arranged to acquire dimensionally differentiated signals;

a joint searcher and channel estimator arranged to essentially concurrently consider the dimensionally differentiated plural signals provided by the antenna structure for determining both a time of arrival and channel coefficient;

wherein the joint searcher and channel estimator comprises:

an antenna signal matrix in which complex values indicative of the dimensionally differentiated signal received in a sampling window are stored as a function of a sampling window time index and a dimensional differentiation index;

a correlator arranged to locate value(s) in the antenna signal matrix for use in determining the time of arrival and the channel coefficient and to generate a correlator output;

a correlator output analyzer arranged to use the value(s) located by the correlator to generate the time of arrival and the channel coefficient;

wherein in locating the values the correlator output analyzer considers a dimensional reception vector formed from the antenna signal matrix with respect to a sampling window time index, the dimensional receptivity vector having a frequency related to a difference between phase components of complex values of the dimensional receptivity vector, there being plural possible frequencies for the dimensional receptivity, the plural possible frequencies being represented by a frequency index; and

wherein for each combination of plural possible frequencies and plural time indexes, the correlator is arranged to calculate:

$Y(n,t) = FFT(n,X(:,t))$

wherein t is the sampling window time index;

X(:,t) is the complex antenna matrix, with : representing all antenna indexes for one sampling window time index;

n is the frequency index.

51. (New) The apparatus of 50, wherein the antenna structure comprises an array of plural antennas, and wherein the signals acquired by different antennas of the array are dimensionally differentiated with regard to a spatial dimension.

52. (New) The apparatus of 51, wherein the antenna array comprises a uniform linear array of plural antennas.

53. (New) The apparatus of 50, wherein the time channel coefficient is a composite channel coefficient which takes into consideration channel impulse responses for channels associated with each of the plural antennas in the antenna array.

54. (New) The apparatus of 50, further comprising a detector arranged to utilize the channel coefficient and the time of arrival to provide a symbol estimate.

55. (New) The apparatus of 50, wherein the wireless communication receiver is a mobile terminal.

56. (New) The apparatus of 50, wherein the wireless communication receiver is a network node.

57. (New) The apparatus of 50, wherein for each combination of plural possible frequencies and plural time indexes, the correlator is further arranged to calculate:

$Y(n,t) = \Sigma\ C_j *FFT(n,X(:,t)),\ j = 1,K$

wherein C_j is a coding sequence symbol value j and K is a length of the coding sequence.

58. (New) The apparatus of 50, wherein the antenna structure comprises an array of plural antennas, and wherein each of the plural possible frequencies for the dimensional receptivity vector represents a different possible direction of arrival of the arriving wavefront.

59. (New) The apparatus of 58, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer is arranged to determine a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer is arranged to use the a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs as the time of arrival of the arriving wavefront; and wherein the correlator output analyzer is arranged to use the frequency index n_max at which $|Y(n,t)|_{max}$ occurs as the direction of arrival of the arriving wavefront.

60. (New) The apparatus of 58, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer is arranged to determine a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer is arranged to obtain an amplitude for the arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of antennas comprising the antenna array.

61. (New) The apparatus of claim 50, wherein the antenna structure comprises an antenna which provides signals for each of successive sets of pilot data received by the antenna as the dimensionally differentiated signals, and wherein each of the plural possible frequencies corresponds to a doppler shift.

62. (New) The apparatus of 61, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer is arranged to determine a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer is arranged to use a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront; and wherein the correlator output analyzer is arranged to use the a frequency index n_max at which $|Y(n,t)|_{max}$ to determine the doppler shift.

63. (New) The apparatus of 61, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer is arranged to determine a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer is arranged to obtain an amplitude for an arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of sets of pilot data in the series.

64. (New) The apparatus of 50, wherein the antenna structure comprises an antenna which provides signals for each of successive sets of pilot data; wherein the joint searcher and channel estimator is arranged to essentially concurrently consider plural signals for the respective successive sets of pilot data for determining both the time of arrival and channel coefficient; wherein each of the sets of pilot data is represented by a pilot set index, and wherein in the dimensional differentiation index is the pilot set index; and wherein the dimensional receptivity vector is formed from the antenna signal matrix with respect to the sampling window time index for the successive sets of pilot data.

65. (New) The apparatus of 50, wherein each of the plural possible frequencies corresponds to a doppler shift.

66. (New) The apparatus of 65, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer is configured to determine a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer uses a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront; and

wherein the correlator output analyzer uses the a frequency index n_max at which $|Y(n,t)|_{max}$ to determine the doppler shift.

67. (New) The apparatus of 50, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer determines a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer obtains an amplitude for an arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of sets of pilot data in the series.

68. (New) The apparatus of claim 64, wherein the joint searcher and channel estimator is arranged to essentially concurrently consider the plural signals for the respective successive sets of pilot data for determining both a time of arrival and channel coefficient by essentially concurrently operating upon a two dimensional functionally dependent matrix, the signals being stored in the matrix as a function of two different indices, a first index being a time index of a sampling window employed for each of the sets of pilot data and a second index indicating for which one of the successive sets of pilot data the signal was obtained.

69. (New) The apparatus of claim 64, wherein the joint searcher and channel estimator is arranged to essentially concurrently consider the plural signals for the respective successive sets of pilot data for determining both a time of arrival and channel coefficient by essentially concurrently operating upon a matrix which stores signals which are dimensionally differentiated by being acquired in differing frame transmission intervals

70. (New) The apparatus of 50,wherein the antenna structure comprises plural antennas, the plural antennas providing respective plural signals indicative of an arriving wavefront; wherein the joint searcher and channel estimator is arranged to essentially concurrently consider plural signals provided by the plural antennas for determining both the time of arrival and channel coefficient; wherein each of the plural antennas in the antenna array is represented by an antenna index, and wherein the dimensional differentiation index is the antenna index; and wherein in the dimensional receptivity vector formed from the antenna signal matrix with respect to the sampling window time index for the plural antennas of the antenna array.

71. (New) The apparatus of 70, wherein each of the plural possible frequencies for the dimensional receptivity vector represents a different possible direction of arrival of the arriving wavefront

72. (New) The apparatus of 70, wherein the correlator output comprises Y(n,t), and wherein the correlator output correlator output analyzer determines a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer uses a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs as the time of arrival of the arriving wavefront; and wherein the correlator output analyzer uses the a frequency index n_max at which $|Y(n,t)|_{max}$ occurs as the direction of arrival of the arriving wavefront.

73. (New) The apparatus of 72, wherein the correlator output comprises Y(n,t), and wherein for each arriving wavefront the correlator output correlator output analyzer determines a qualifying absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer uses a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs as the time of arrival of the arriving wavefront; and wherein the correlator output analyzer uses the a frequency index n_max at which $|Y(n,t)|_{max}$ occurs as the direction of arrival of the arriving wavefront.

74. (New) The apparatus of 70, wherein the correlator output comprises Y(n,t), and wherein the correlator output analyzer determines a maximum absolute value $|Y(n,t)|_{max}$, wherein the correlator output analyzer obtains an amplitude for the arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of antennas comprising the antenna array.

75. (New) A wireless communication receiver comprising:

an antenna structure comprising plural antennas arranged to provide respective plural series of signals for successive sets of pilot data;

a joint searcher and channel estimator arranged to essentially concurrently consider the plural series of signals for determining both a time of arrival and channel coefficient;

wherein each of the plural antennas in the antenna array is represented by an antenna index, wherein each of the sets of pilot data is represented by a pilot set index, and wherein the joint searcher and channel estimator comprises:

an antenna signal matrix in which a complex value indicative of a signal received in a sampling window is stored as a function of a sampling window time index, the antenna index, and the pilot set index;

a correlator which performs a Fast Fourier Transformation (FFT) calculation to generate a correlator output;

a correlator outputanalyzer which uses the correlator output to generate the time of arrival and the channel coefficient, wherein in performing the calculation the correlator considers plural possible frequencies of complex values along the antenna index and plural possible frequencies of complex values along the pilot set index, plural possible frequencies of complex values along the antenna index corresponding to plural possible directions of arrival and being represented by a frequency index n_1, the plural possible frequencies of complex values along the antenna index corresponding to plural possible doppler shifts and being represented by a frequency index n_2, and wherein for each combination of plural possible direction of arrival frequencies, plural possible doppler frequencies, and plural time indexes, the correlator calculates:

$Y(n_1,n_2,t) = FFT(n_1,n_2,X(:,:,t))$

wherein t is the sampling window time index; X(:,t) is the complex antenna matrix (with the colon ":" representing all antenna indexes for one sampling window time index).

76. (New) The apparatus of claim 75, wherein for each combination of plural possible frequencies and plural time indexes, the method comprises evaluating the following expression:

$Y(n,t) = \Sigma\ C_j *FFT(n,X(:,:,t)),\ j = 1,K$

wherein C_j is a coding sequence symbol value j and K is the length of the coding sequence.

77. (New) The apparatus of claim 75, wherein the correlator output comprises $Y(n_1,n_2,t)$, and wherein the correlator output analyzer determines a maximum absolute value $|Y(n_1,n_2,t)|_{max}$, wherein the correlator output analyzer uses a sampling window time index t_max at which $|Y(n_1,n_2,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront; wherein the correlator output analyzer uses the a direction of arrival frequency index n_1_max at which $|Y(n_1,n_2,t)|_{max}$ occurs to determine the doppler shift direction; and

wherein the correlator output analyzer uses the a doppler frequency index n_2_max at which $|Y(n_1,n_2,t)|_{max}$ occurs to determine the doppler shift direction.

78. (New) The apparatus of claim 75, wherein the correlator output comprises $Y(n_1,n_2,t)$, and wherein the correlator output analyzer determines a maximum absolute value $|Y(n_1,n_2,t)|_{max}$, wherein the correlator output analyzer obtains an amplitude for an arriving wavefront by dividing $|Y(n_1,n_2,t)|_{max}$ by a product of a number of sets of pilot data in the series and a number of antennas in the antenna array.

79. (New) A method of operating a wireless communication receiver comprising:

acquiring dimensionally differentiated signals at an antenna structure;

storing, in an antenna signal matrix, complex values indicative of the dimensionally differentiated signals received in a sampling window as a function of a sampling window time index and a dimensional differentiation index;

concurrently using the dimensionally differentiated signals for determining both a time of arrival and channel coefficient by performing the acts of:

locating value(s) in the antenna signal matrix for use in determining the time of arrival and the channel coefficient by using a dimensional reception vector formed from the antenna signal matrix with respect to a sampling window time index, the dimensional receptivity vector having a frequency related to a difference between phase components of complex values of the dimensional receptivity vector, there being plural possible frequencies for the dimensional receptivity, the plural possible frequencies being represented by a frequency index; and

calculating, for each combination of plural possible frequencies and plural time indexes:

$$Y(n,t) = FFT(n,X(:,t))$$

wherein t is the sampling window time index;

X(:,t) is the complex antenna matrix, with : representing all antenna indexes for one sampling window time index;

n is the frequency index; and,

using the value(s) located to generate the time of arrival and the channel coefficient.

80. (New) The method of claim 79, wherein for each combination of plural possible frequencies and plural time indexes, calculating:

$Y(n,t) = \Sigma\ C_j$ *FFT(n,X(:,t)), j = 1,K

wherein C_j is a coding sequence symbol value j and K is a length of the coding sequence.

81. (New) The method of claim 79, wherein the antenna structure comprises an array of plural antennas, and wherein each of the plural possible frequencies for the dimensional receptivity vector represents a different possible direction of arrival of the arriving wavefront.

82. (New) The method of claim 81, further comprising in the locating step generating an output which comprises Y(n,t), and further comprising determining a maximum absolute value $|Y(n,t)|_{max}$, using the a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs as the time of arrival of the arriving wavefront; and using the a frequency index n_max at which $|Y(n,t)|_{max}$ occurs as the direction of arrival of the arriving wavefront.

83. (New) The method of claim 81, further comprising in the locating step generating an output which comprises Y(n,t), and further comprising:

determining a maximum absolute value $|Y(n,t)|_{max}$; and

obtaining an amplitude for the arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of antennas comprising the antenna array.

84. (New) The method of claim 79, wherein the antenna structure comprises an antenna which provides signals for each of successive sets of pilot data received by the antenna as the dimensionally differentiated signals, and wherein each of the plural possible frequencies corresponds to a doppler shift.

85. (New) The method of claim 84, wherein the locating step further comprises generating an output which comprises Y(n,t), and further comprising:

determining a maximum absolute value $|Y(n,t)|_{max}$;

using a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront; and

using the a frequency index n_max at which $|Y(n,t)|_{max}$ to determine the doppler shift.

86. (New) The method of claim 84, wherein the locating step further comprises generating output comprising Y(n,t), and further comprising:

determining a maximum absolute value $|Y(n,t)|_{max}$; and

obtaining an amplitude for an arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of sets of pilot data in the series.

87. (New) The method of claim 79, wherein the dimensionally differentiated signals comprise successive sets of pilot data, and wherein the method further comprises:

concurrently using the signals for each of the successive sets of pilot data for determining both a time of arrival and channel coefficient;

wherein each of the sets of pilot data is represented by a pilot set index;

storing a complex value indicative of the signal received in a sampling window an antenna signal matrix as a function of a sampling window time index and the pilot set index;

forming the dimensional receptivity vector from the antenna signal matrix with respect to a sampling window time index for the plural sets of pilot data;

calculating, for each combination of plural possible doppler frequencies and plural time indexes, Y(n,t) = FFT(n,X(:,t)), wherein n is the doppler frequency index.

88. (New) The method of claim 87, wherein for each combination of plural possible frequencies and plural time indexes, the method comprises evaluating the following expression:

$Y(n,t) = \Sigma\ C_j *FFT(n,X(:,t)),\ j = 1,K$

wherein C_j is a coding sequence symbol value j and K is the length of the coding sequence.

89. (New) The method of claim 87, wherein the correlator output comprises Y(n,t), and further comprising determining a maximum absolute value $|Y(n,t)|_{max}$.

90. (New) The method of 89, further comprising:

using a sampling window time index t_max at which $|Y(n,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront; and

using the doppler frequency index n_max at which $|Y(n,t)|_{max}$ to determine the doppler shift direction.

91. (New) The method of 89, further comprising obtaining an amplitude for the arriving wavefront by dividing $|Y(n,t)|_{max}$ by a number of sets of pilot data in the series.

92. (New) The method of claim 87, further comprising concurrently using the signals for each of successive sets of pilot data for determining both a time of arrival and channel coefficient by essentially concurrently operating upon a two dimensional functionally dependent matrix, the signals being stored in the matrix as a function of two different indices, a first index being a time index of a sampling window employed for each of the sets of pilot data and a second index indicating for which one of the successive sets of pilot data the signal was obtained.

93. (New) The method of claim 87, further comprising concurrently using the signals for each of successive sets of pilot data for determining both a time of arrival and channel coefficient by essentially concurrently operating upon a matrix which stores signals which are dimensionally differentiated by being acquired in differing frame transmission intervals.

94. (New) The method of claim 79, further comprising obtaining from plural antennas of the antenna structure respective plural signals indicative of an arriving wavefront,

associating each of the plural antennas in the antenna array with an antenna index.

95. (New) The method of claim 94, wherein each of the plural possible frequencies for the dimensional receptivity vector represents a different possible direction of arrival of the arriving wavefront.

96. (New) The method of claim 94, wherein the correlator output comprises Y(n,t), and further comprising determining a maximum absolute value $|Y(n,t)|_{max}$.

97. (New) A method of operating a wireless communication receiver comprising:

obtaining from plural antennas respective plural series of signals for successive sets of pilot data;

concurrently using the plural series of signals for determining both a time of arrival and channel coefficient;

wherein each of the plural antennas in the antenna array is represented by an antenna index, wherein each of the sets of pilot data is represented by a pilot set index, wherein the step of concurrently using the plural signals for determining both the time of arrival and the channel coefficient is performed by a joint searcher and channel estimator, and further comprising the acts of the joint searcher and channel estimator:

storing a complex value indicative of the signal received in a sampling window an antenna signal matrix as a function of a sampling window time index, the antenna index, and the pilot set index;

performing a Fast Fourier Transformation (FFT) calculation to generate a correlator output;

using the correlator output to generate the time of arrival and the channel coefficient;

wherein in performing the calculation the correlator considers plural possible frequencies of complex values along the antenna index and plural possible frequencies of complex values along the pilot set index, plural possible frequencies of complex values along the antenna index corresponding to plural possible directions of arrival and being represented by a frequency index n_1, the plural possible frequencies of complex values along the antenna index corresponding to plural possible doppler shifts and being represented by a frequency index n_2, and wherein for each combination of plural possible direction of arrival frequencies, plural possible doppler frequencies, and plural time indexes; and wherein the correlator calculates:

$Y(n_1,n_2,t) = FFT(n_1,n_2,X(:,:,t))$

wherein t is the sampling window time index; X(:,:,t) is the complex antenna matrix (with the colons ":,:," representing all antenna indexes and all pilot indexes for one sampling window time index).

98. (New) The method of claim 97, wherein for each combination of plural possible frequencies and plural time indexes, the method comprises evaluating the following expression:

$Y(n,t) = \Sigma\, C_j * FFT(n,X(:,:,t)),\ j = 1,K$

wherein C_j is a coding sequence symbol value j and K is the length of the coding sequence.

99. (New) The method of claim 97, wherein the correlator output comprises $Y(n_1,n_2,t)$, and further comprising determining a maximum absolute value $|Y(n_1,n_2,t)|_{max}$.

100. (New) The method of claim 97, further comprising:

using a sampling window time index t_max at which $|Y(n_1,n_2,t)|_{max}$ occurs to determine the time of arrival of an arriving wavefront;

using an antenna index n_1_max at which $|Y(n_1,n_2,t)|_{max}$ occurs to determine the direction of arrival of an arriving wavefront; and

using the doppler frequency index n2_max at which |Y(n1,n2,t)|max to determine the doppler shift direction.